



Climate Change: Opportunities for Forestry?

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Possible Opportunities

- Faster tree growth
(others talked about this)
- Greenhouse gas emission offsets
(this talk)



Emission Offsets

- Benefits created one place and counted another
- Create by:
 - Reducing ongoing flow of emissions
 - Removing greenhouse gases from the atmosphere
- Must be verified



Baselines

- Offset is benefit beyond a baseline
- Capped systems: Baseline assigned
- Outside cap: Baseline is what would have happened without the project
 - Most objective: Look at what others do
- Over time, baselines can be constant, rise, or fall



Greenhouse Gases From Land Management

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous Oxide (N₂O)
- Fuel emissions from operations



GHGs Not Generally Addressed in Land Management

- **Other Kyoto gases:** Hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride
- **Other radiative gases:** Ozone, aerosols, black carbon, water vapor, halocarbons
- **Other effects:** Indirect drivers (NO_x , CO, VOC), solar, volcanos, land cover albedo



Mitigation Activities

- Reduce emissions
 - Reduce deforestation
 - Reduce fossil fuel use
 - Reduce fertilizer N_2O
 - Reduce rice CH_4
- Remove GHGs from atmosphere (sinks)
 - Increase forest or wood product biomass
 - Restore soil carbon

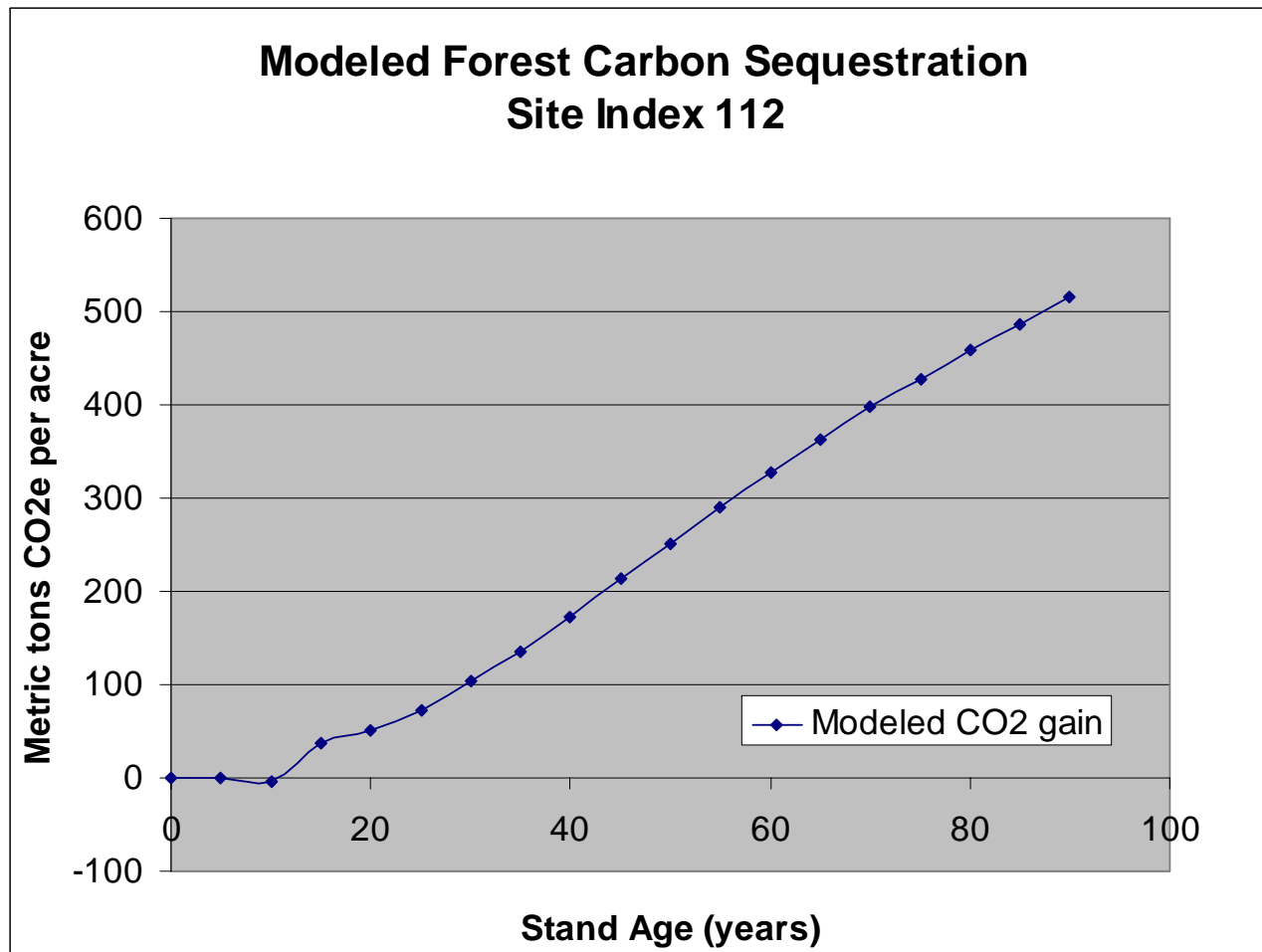


Reversibility

- Reversible: soil & forest biomass sequestration
- Irreversible: fuel use reductions
- All terrestrial and geologic stores can be released, including coal deposits
- Must monitor reversible offsets
 - Ongoing monitoring is an ongoing cost



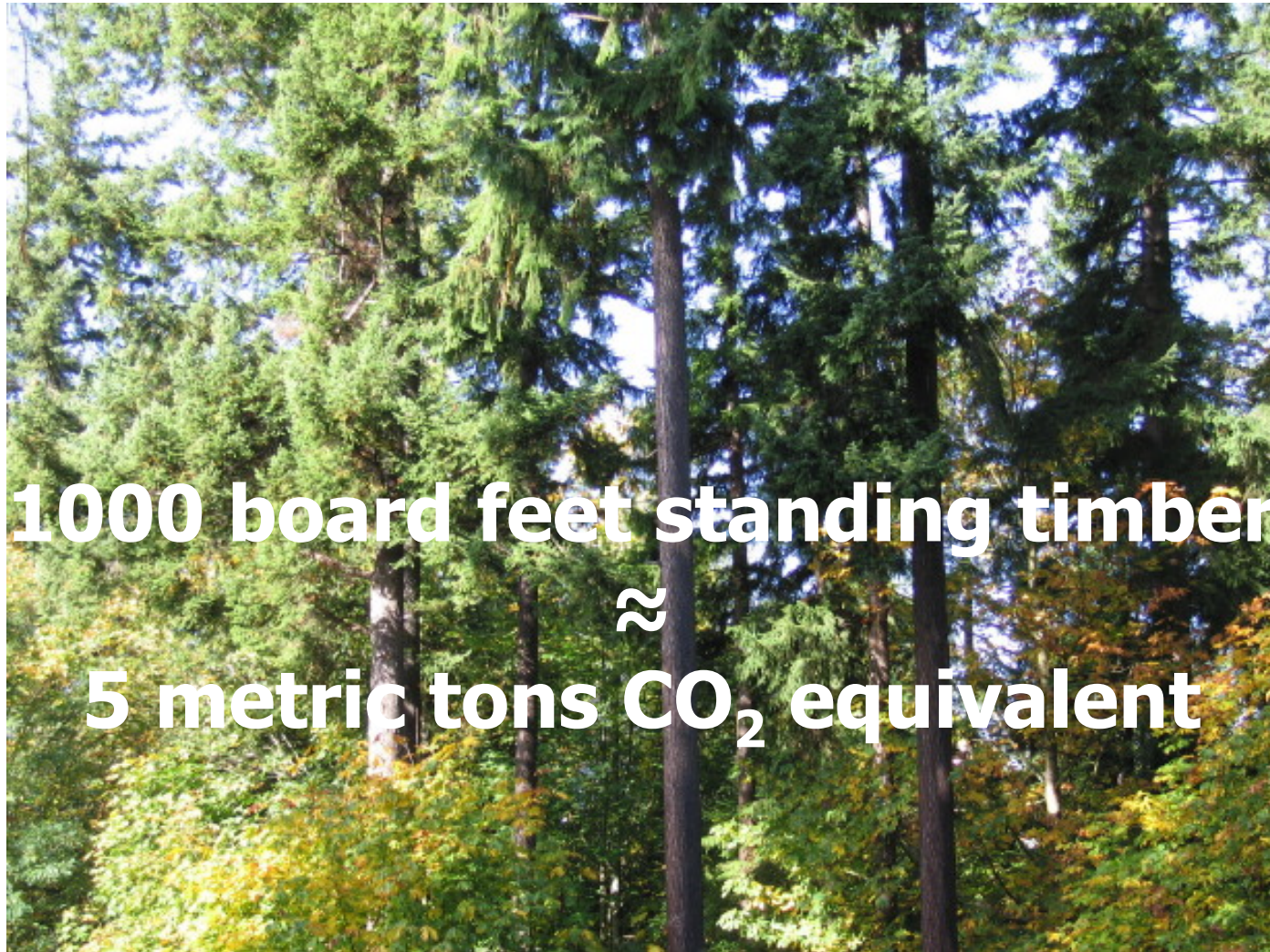
Carbon in New Trees



Relative to
carbon stock
present
immediately
after clearcut
harvest



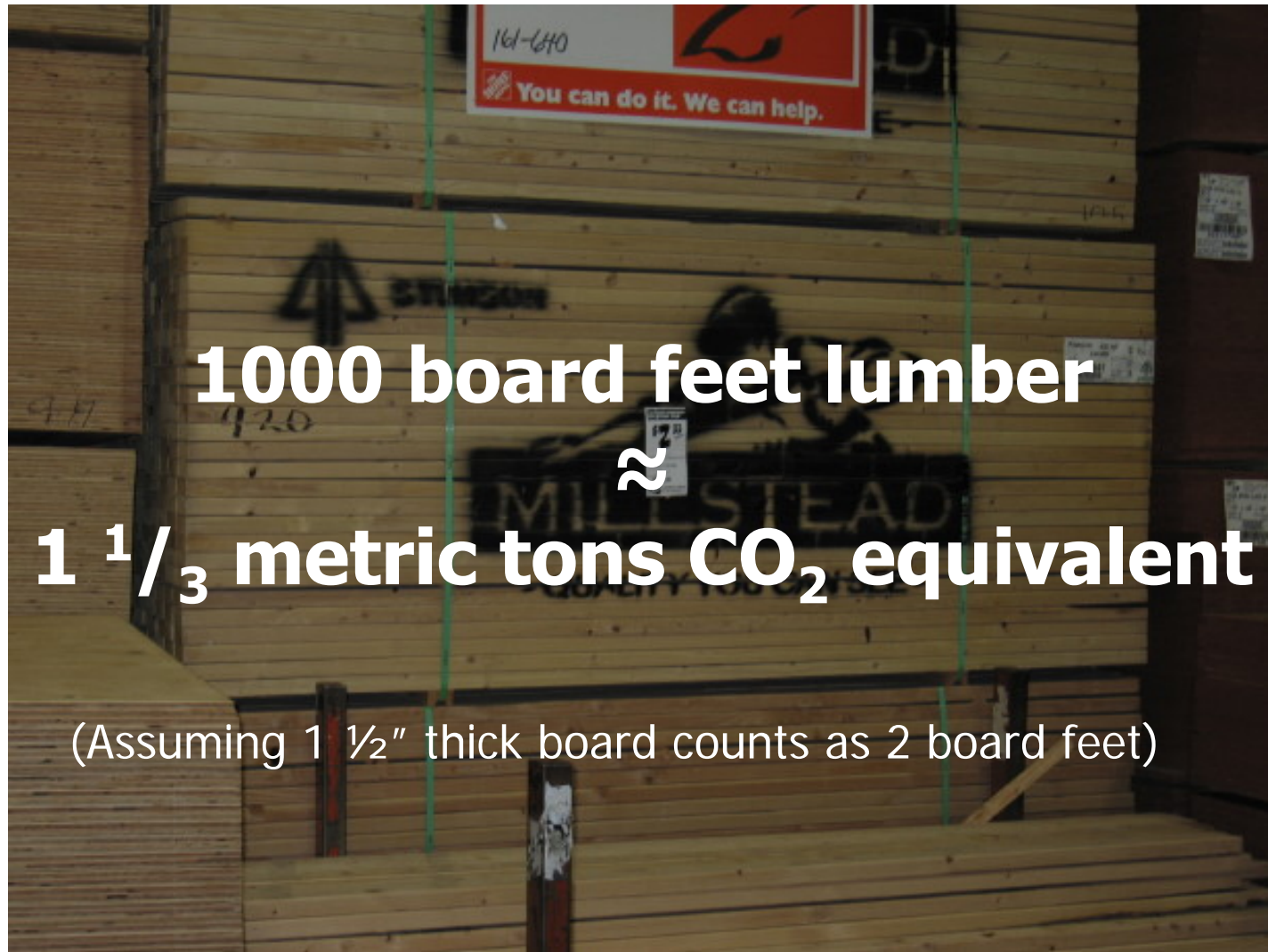
Carbon in Standing Trees



**1000 board feet standing timber
≈
5 metric tons CO₂ equivalent**



Carbon in Wood Products



1000 board feet lumber

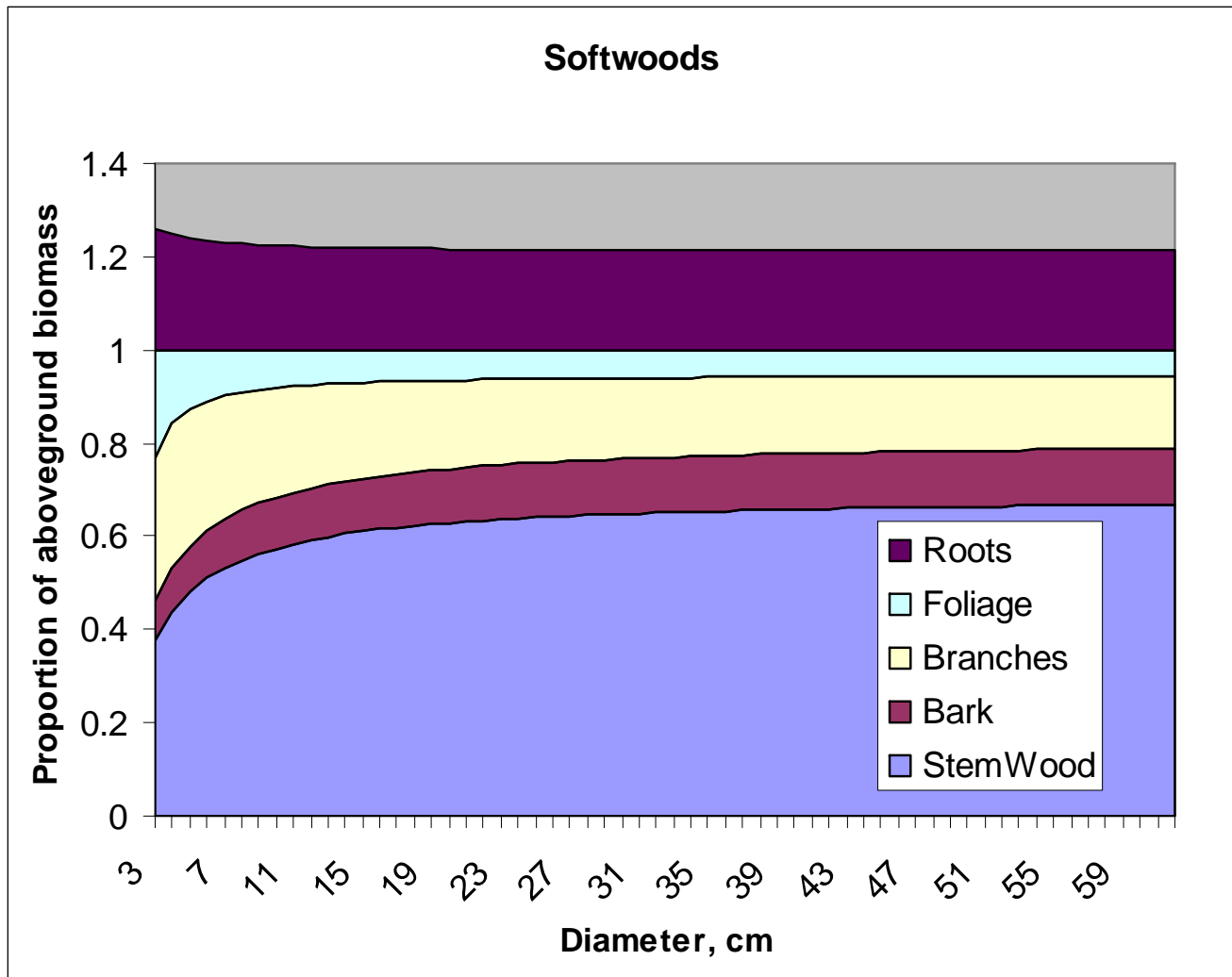
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1 1/3 metric tons CO₂ equivalent

(Assuming 1 1/2" thick board counts as 2 board feet)



Why Products Have Fewer Tons



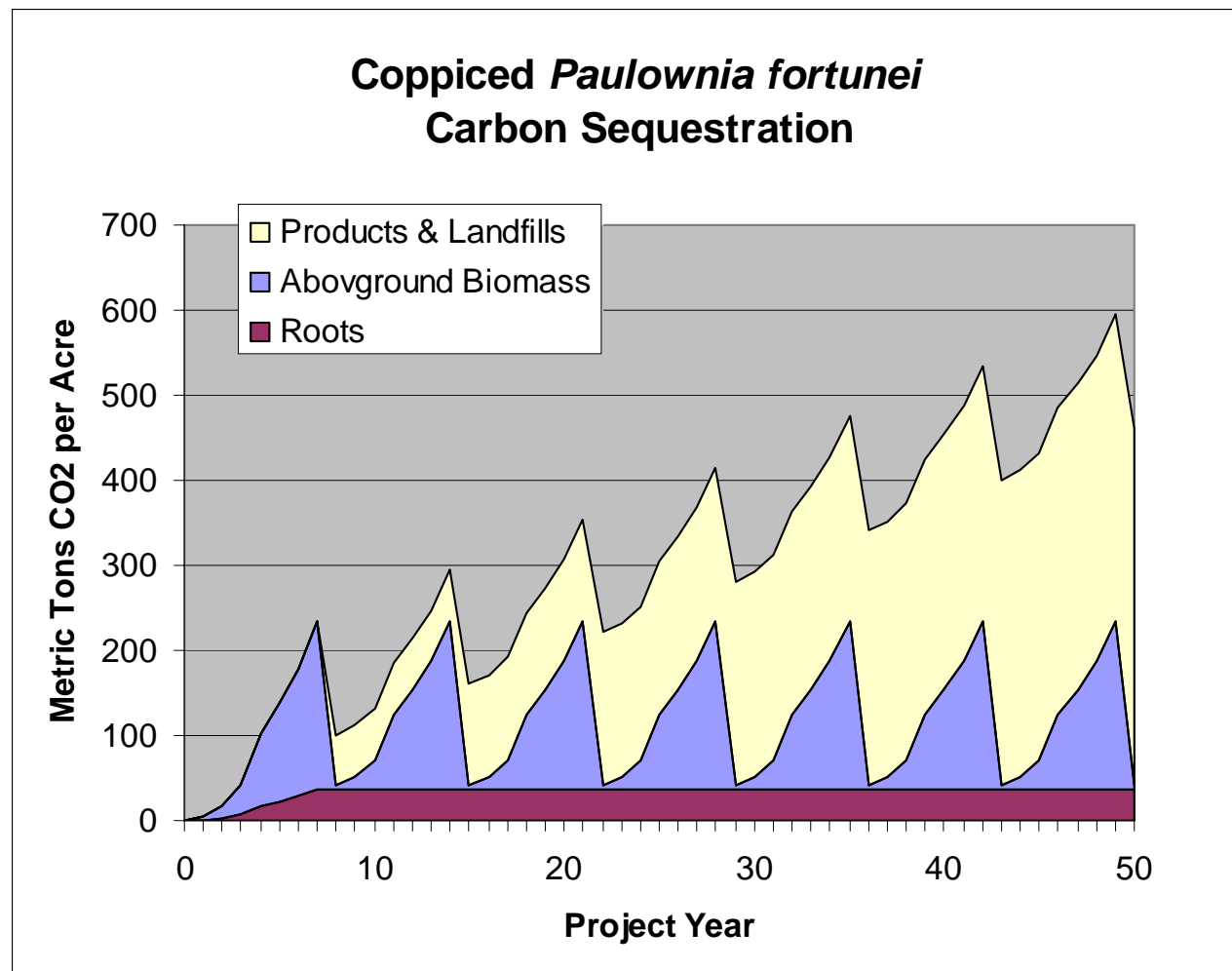


Starting Conditions Matter

- Carbon stocks tend toward equilibrium
 - Afforesting crop land stores carbon
 - Harvesting old forest releases carbon
- Disturbance history goes both ways
 - Prior soil disturbance reduces soil C stock
 - Prior forest disturbance can create large stocks of woody debris



Accounting Rules Matter: Wood Products



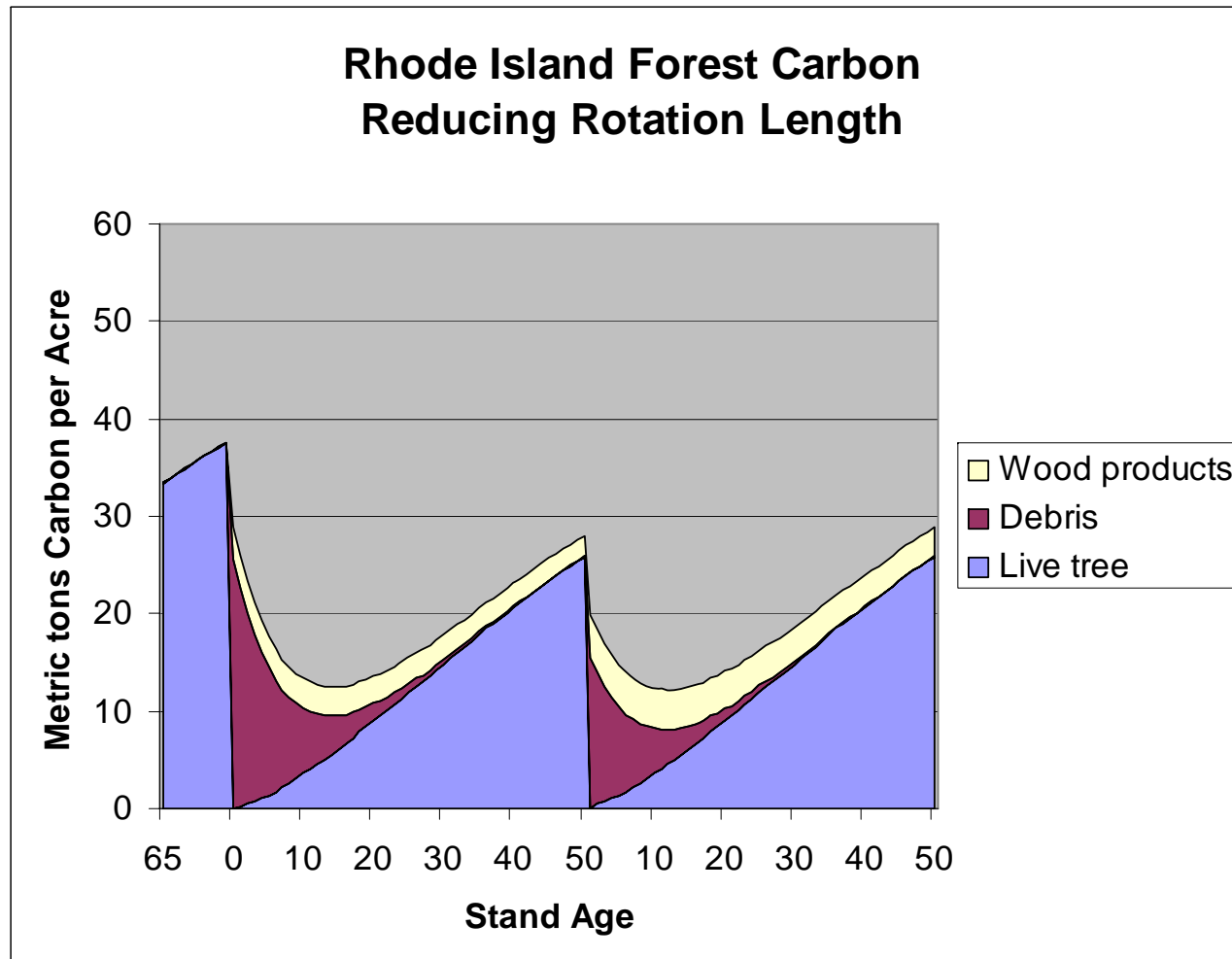


Net GHG Effect May be Surprise

- Ecological knowledge informs estimate of net GHG effect
 - Thinning forests to reduce stand-replacing fire increases emissions
 - Soil erosion: emission or sink?
 - Wetland restoration for C storage may cause net warming from CH₄ emissions
 - Surface soil C increase under afforestation may be translocation



Forest Management Intensification





Avoided Emissions: Leakage

- Avoiding deforestation can avoid emissions and create offsets
- If product supply is decreased production is displaced ("leakage")
- Leakage > 85% (Murray et al. 2004)
- Avoid leakage by replacing lost supply



Extending Rotations is Expensive

- Increasing average stand carbon stock can create offsets
- Factors driving up cost:
 - Pay for deferring harvest
 - Increment of increased stock modest relative to total stock
- Cost generally $> \$100 \text{ ton CO}_2\text{e}$



Other Landowner Considerations

- Opportunity cost: What revenues would be forgone by doing GHG project?
 - Future options foreclosed by project (e.g. development foreclosed by sequestration easement)
- Cash flow timing: When will costs and revenues occur?
- Transaction costs
- Perceived risks

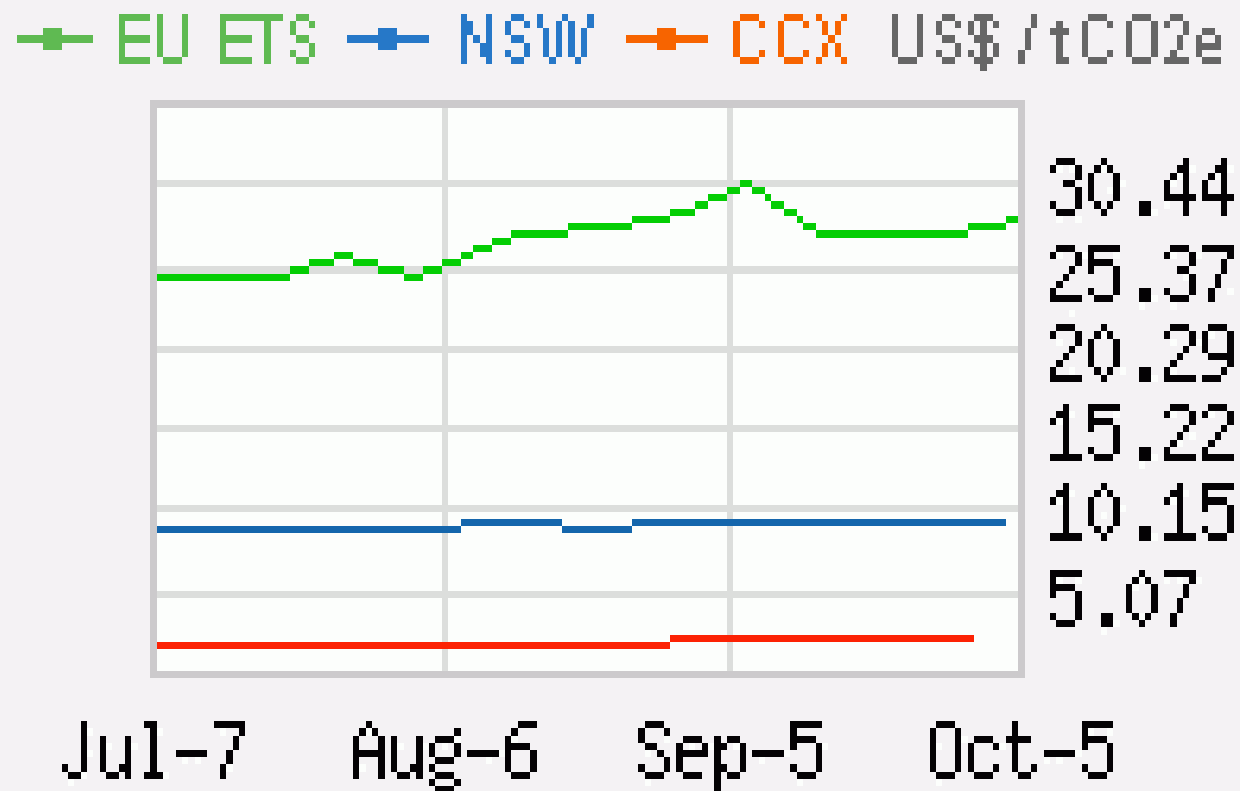


Offset Markets

- Kyoto Protocol
 - Preparatory & compliance, EU-ETS
- Chicago Climate Exchange
- Brokers
 - Natsource, CO₂e
- Australian: New South Wales
- Individual buyers
 - World Bank, Climate Trust



Offset Prices



<http://www.ecosystemmarketplace.com/>



Why Offset Prices Vary

- Demand
 - Low demand (voluntary market) = low price
- Reliability (risk to buyer)
 - Lower price if offset not yet created or not guaranteed
 - Low price if rules not yet set
- Permanence
 - Temporary offsets = lower price



U.S. Emission Cap & Trade

- Would create demand for offsets
 - Could include forest offsets
- Could assign baseline for forest projects
- Could cap terrestrial emissions
 - If cap lands, could make sequestration in existing product streams count as offsets



Thank you

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